Direct Electrodeposition of Polypyrrole on Al 2024-T3 by Electron Transfer Mediation

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Our laboratory is exploring a variety of electroactive conducting polymers (ECPs) for corrosion control. One of the challenges in this field of research is the formation of a uniform adherent coating of the desired ECP on the active metal. In this work, the direct galvanostatic electrodeposition of polypyrrole (Ppy) on Al 2024-T3 alloy was investigated. Using sodium *p*-toluene sulfonate (pTS) as electrolyte and polymer counterion (dopant anion), only patchy poorly adhering films of Ppy could be formed. This was attributed to the formation of an insulating oxide layer on the alloy surface (i.e., alloy corrosion) at the positive deposition potential required. However, in the presence of the electron transfer mediator Tiron® (4,5-dihydroxy-1,3-benzenedisulfonic acid disodium salt), the deposition potential was ca. 400 mV less positive than that observed in the pTS electrolyte, and uniform, conducting, well-adhering Ppy films were produced. In these experiments, Tiron also served as the electrolyte and polymer counterion (dopant anion). The current efficiency for polymer deposition was estimated to be 100%. Thus, it appears that direct electrodeposition of the polymer on the active metal can be accomplished without significant corrosion of the metal. The resulting Ppy films have been characterized by scanning electron microscopy, atomic force microscopy, x-ray photoelectron spectroscopy, adhesion measurements and four-point conductivity measurements. The results of these measurements will be discussed.